responsibility for the environment

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ORGANISMALITY GROUNDS SPECIES COLLECTIVE RESPONSIBILITY:

Abstract

It is frequently claimed that our species is responsible for climate change, for a new impending mass extinction, for destabilising ecosystems dynamics etc. These claims might be interpreted literally as meaning that it is our species, not merely its constituent organisms, that is causing climate change, biodiversity loss and ecosystem upheaval. Such literal interpretation depends on what kind of answer is given to the general theoretical question concerning whether supra-organismal biological entities such as groups, populations and species can be morally responsible for anything as collectives. I shall argue that organismality is the biological property grounding species collective moral responsibility. The question is thus whether our species is organismal enough to make it a morally responsible causal agent.

1. Framing the issue: from political philosophy to biology

Virtually all ecosystems are affected by human-induced dynamics such as population growth, depletion of natural resources and global warming. It is therefore unsurprising that estimating the causal effect of our species' activities on the biosphere is a major concern of a plethora of natural and applied sciences. In turn, causal analysis informs ethical debates concerning our species' responsibility towards the biosphere, other species and future human generations. But ascriptions of collective responsibility are controversial for a number of reasons[1]. After all, species can be seen as mere collections of individual organisms without unified collective moral agency, so that moral responsibility can ultimately be fully distributed between their constituent organisms, i.e., the only relevant

[1] Smiley 2017.

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causal agents. Thus, in order to make ascriptions of collective responsibility meaningful, we need to characterise the conditions that make a collection of individual organisms a unified collective causal agent and, as such, a putative moral agent. In this article I will mainly focus on the issue of causal agency.

The literature in political philosophy has made a series of contributions in this sense, particularly concerning the characterization of the organisational features that a collective must possess in order to be more than the sum of its constituent individual organisms. Significantly, French[2] distinguishes between *aggregate* and *conglomerate* collectives. While the first are collections of individual organisms without significant social structure and whose behaviour is reducible to the additive behaviour of the individual organisms, the latter are organizations of individual organisms whose «…. identity is not exhausted by the conjunction of the identities of the persons in the organization»[3]. In particular, French emphasizes the existence of a set of *enforced standards of conduct* regulating the behaviour of the individual organisms of the conglomerate collective, standards that are lacked by aggregate collectives[4] . On a similar tone, Shockley argues that, in some circumstances, causal and moral responsibility cannot be fully distributed between the individual organisms of the collective because the latter exerts coordinating control on their behaviour[5]. While May argues that, when individual organisms share the same intention, the explanation should be couched, at least in some cases, in terms of the causal capacities of the group structure[6]; thus, "collective intentions" are irreducible to the intentions of individual organisms. The unifying theme of all these contributions is that the collective exerts some kind of control or constraint on the behaviour of the individual organisms, which implies the rejection of strong forms of methodological individualism (an issue on which I shall return in Section 4).

As it is frequent in science, metaphors and analogies are used in order to conceptualise the behaviour of hierarchically organised complex systems with many components. These figures of speech are frequently transferred between disciplines. Two important analogies for understanding coordinated behaviour, control and constraint have pervaded the literature in the life and social sciences. The first is the *human agency* analogy which, translated to the conceptualisation of the behaviour of collectives, would provide a way to understand them as *subjects* with causal and moral agency. The crucial epistemological ingredient of the analogy is the idea of centralised control, whereby a higher-level agent

[2] French 1984.

[3] *Ibidem*: 13.

[4] *Ibidem*: 14.

[5] Shockley 2007.

[6] May 1987: 65.

(e.g., a "homunculus") controls the behaviour of the lower-level components. A long tradition of exceptionalist thinking, stretching from Aristotle through Descartes to Kant, posits that humans are unique in being able to represent past and future scenarios and take rational decisions. While reason is the epitome of centralised control, this analogy has frequently imbued the practice of the life sciences, from immunology (i.e., the self model of immunological tolerance) to neurophysiology:

> Modern biologists have abandoned the separate substance idea, but many still cling to a materialist version of the same mistake, based on the idea that somewhere in the brain the self is to be found as some neuronal process[7].

This model of centralised control is dictatorial: the homunculus is the emperor of the body not on a par with other body's components. The question is thus whether a conceptual model of this kind can be used to understand collectives' behaviour. Historically, many attempts to model social phenomena in terms of centralised control have been proposed. The frequent appeals in the Marxist tradition to the "collective consciousness" of the proletariat are emblematic in this sense[8]. But there is an alternative: the collective might exhibit the distributed control typical of collectives of cells, tissues and organs such as multicellular organisms. This has been called the *body politic* analogy:

> On the same grounds that the sociologist affirms that a society is an organism, the biologist declares that an organism is a society[9].

The basic idea of this analogy is that there is a structural similarity between the processes of coordination, control and constraint between cells, tissues and organs on the one hand and that of individual organisms embedded in social and political institutions on the other. This analogy makes the postulation of the homunculus unnecessary[10].

My general aim in this article is to clarify how biology can inform bioethical debates concerning putative species moral responsibility. More specifically, my aim is to assess under what circumstances a collective of individual organisms such as our biological species can be considered a causal agent with putative moral responsibility by taking seriously the analogy with multicellular organisms. The thesis that will be proposed is that *organismal causal agency* is a necessary (but not sufficient) condition for moral agency. In Section 2 I shall identify

[7] Noble 2008: 25.

[8] Levine, Sober, Wright 1992.

[9] Charles Otis Whitman, see Sapp 2003: 82.

[10] Varela 1999, Noble 2008.

organismality – a term introduced in the biological literature, as far as I know, by Pepper and Herron[11] – as the key property grounding ascriptions of causal agency. In Section 3 I shall evaluate whether our species is sufficiently organismal to be a causal agent. In Section 4 I shall propose a way to understand our species' behaviour in order to make sense of its eventual moral responsibility as a collective, issue touched in Section 5. My argument is biologically-informed but nonetheless complementary to the analysis provided by political philosophers defending genuine collective responsibility.

2. Groundwork on collective causal agency

What is causal agency? Can non-biological entities be causal agents? Wind – a diffused entity – causes waves while the moon – a distinct entity – causes tides. Biological entities such as Dna sequences, ribosomes and proteins are somehow causes of the formation of, respectively, Rna transcripts, amino acids sequences and catalytic reactions. Even though ascriptions of causal agency of this kind are common in the biological literature[12], we must distinguish between, on the one hand, the power of an entity to cause events and bring about changes and, on the other, a causally stronger notion of agency[13]. Being causes is not enough in order to be causal *agents*: wind, the moon, Dna sequences, ribosomes and proteins are causes, but they are not intuitively agents. What is agency then?

One possible answer is the following: agents are entities displaying the two properties of self-interest and causal autonomy. The first property refers to the existence of an internal teleology. In particular, all organisms, from bacteria to humans, strive to make a living out of what they have. Less trivially, they strive to preserve their identity through time via the assimilation of environmental resources. This capacity of striving for a basic existential goal (i.e., survival) might be connected to the capacity of having a perspective from which to value the nature of the encounters with the environment, a subjective point of view, a primitive form of sentience[14]. Wind, the moon, proteins, ribosomes, genomes and also thermostats, robotic vacuum cleaners and other machines are incapable of doing this. The second property, i.e., causal autonomy, refers to the capacity of initiating causal chains and being an autonomous source of activity instead of a mere «… passive sufferer of the effects of external forces»[15]. The issue of causal autonomy is connected with the nature of free will and is complicated

[11] Pepper, Herron 2008.

[12] Fox Keller 2002.

[13] Schlosser 2015.

[14] Weber, Varela 2002.

[15] Barandiaran, Di Paolo, Rohde 2009: 370.

by the existence of incontrovertible introspective evidence of freedom. I suspect that if the kind of freedom we experience directly indeed exists at all instead of being delusional, it must be realised independently of possessing sophisticated representational capacities. In summary, I suggest that x is a causal agent if and only if x possesses self-interests and causal autonomy. As a consequence, I will henceforth assume that all unicellular and multicellular organisms are causal agents because they possess self-interests and causal autonomy. Of course, it remains an open question whether they are also moral agents. Again, I must stress that the focus of my analysis is on substantiating biologically the notion of causal agency for the reason that I will be arguing that causal agency is a necessary condition for moral responsibility[16].

Are supra-organismal biological entities causal agents as well? I shall for the sake of simplicity only focus on species in the remainder; the reason is that this will not affect the applicability of my argument to sub-species supra-organismal aggregates[17]. The reason is that the compositional complexity of the supra-organismal aggregate is not relevant for causal agency. What is relevant is rather the organisational complexity, functional integration or organismality of the supra-organismal aggregate[18]. In order to answer the question "are

[16] Causal agency ascription to biological entities and processes generates an important bio-philosophical problem. In a recent book, Okasha (2018) unpacks this complex issue by dismissing various claims (e.g., that natural selection is a genuine agent). The most interesting argument Okasha defends is that only organisms have goals and, relatedly, that it is only organisms displaying biologically realised "consistency of purpose" (e.g., absence of "antagonistic traits") that can be genuinely treated as causal agents. This means that there is no genuine non-organismal agency. Despite its trait-oriented bias, Okasha's analysis is broadly in line with theories of organismality as "unanimity of interest" such as that advocated by Queller, Strassmann (2009, 2016), even though such unanimity is between the component parts (often organisms themselves) of a biological entity rather than between their traits. Indeed, theories of organismality provide a much richer analytical framework for my purposes as they stress the fundamental point that some organismality measure can be applied across the biological spectrum, significantly to all supra-organismal biological entities rather than merely to paradigmatic organisms. Obviously, the issue of linking causal agency to moral responsibility remains beyond the reach of biological theories of organismality.

[17] By aggregate I hereby simply mean a group of components constituting a collective, without assuming anything about the organisational nature of the collective.

[18] Whether an aggregate is composed of 2 or more organisms is irrelevant for my analysis in the following two senses. First, the demonstration that a supra-organismal aggregate composed of 2 organisms is a causal agent is a proof of principle that compositionally more complex supra-organismal aggregates might in principle be causal agents. In this sense, the fact that unicellular eukaryotes composed of one host-cell and one endosymbiont are causal agents is a proof of principle that multicellular eukaryotes might be causal agents. Conversely, the demonstration that a supra-organismal aggregate composed of n organisms is a causal agent is a proof of principle that supra-organismal aggregates compositionally simpler might in principle be causal agents. The fact that a human or a big group of organisms (Sober, Wilson 1998) can be causal agents is a proof of principle that insects and smaller groups might be causal agents. In all these cases,

species causal agents?" I propose to start from a basic biological consideration. Multicellular organisms are collections of cells or supra-cellular aggregates, while species are collections of organisms or supra-organismal aggregates. However, while collections of cells such as multicellular organisms (e.g., humans) are the epitome of causal agents, collections of organisms such as species are intuitively not: the agency of a species seems to be entirely parasitic on the agency of its constituent organisms. Let us try to unpack the rationale of this intuition by taking a cursory look at the literature in environmental ethics.

In a series of publications, Johnson has argued that species are causal agents[19]. The upshot of Johnson's analysis is that, starting from the thesis that species are individuals, it is reasonable to infer that species are living entities independently of their constituent organisms and, then, to reasonably infer that species have self-interests irreducible to those of their constituent organisms, where such interests ground their agency and moral responsibility.

All the inferences of this argument are controversial. The thesis that species are individuals can be interpreted in two ways: as a biologically trivial mereological thesis according to which species are concrete particulars made up of parts or as the thesis that species are "organismal" in the sense of displaying organism-like properties such as a certain level of functional integration. Only in the second sense species are cohesive units of organisms analogous to the cohesive units of molecules or cells constituting unicellular and multicellular organisms respectively[20]. Johnson seems to think about individuality not in purely mereological terms, otherwise, as Sandler and Crane correctly argue: «The mere fact that species belong to the ontological category of "concrete, particular, persisting things comprised of material parts" is clearly insufficient to ground morally considerable interests»[21]. Johnson's analysis is also controversial because it seems unnecessary to consider species alive, as organisms are, in order to be causal agents. Again, I agree with Sandler and Crane[22] when they note: «The fact that species are living (on a sufficiently liberal definition) is thus doing no real work toward establishing that they have interests. The real question is whether something as loosely aggregated in terms of cohesion and organisation as species can have interests»[23]. What could be a species' self-interest? Johnson proposes that

supra-organismal aggregates are organismal because of their organisational complexity, not because the number of organisms composing the aggregate exceeds a certain threshold.

[19] Johnson 1991; 1992.

[20] Casetta, Vecchi 2019.

[21] Sandler, Crane 2006.

[22] *Ibidem*: 72.

[23] My disagreement with Johnson is not that I believe that there exist non-living things with self-interests. My point is that the question of whether species are alive independently of its component organisms is confused. I also consider the analogous question concerning whether

a species has self-interests characterisable in terms of self-maintenance (e.g., in persisting as the same species by maintaining a certain level of genetic diversity in order to be able to resist environmental fluctuations, by being adapted to its environment, by maximising the number of its constituent members). Similarly, Sandler and Crane[24] suggest that longevity, population size and adaptability to evolutionary pressures are indicators of the capacity of a species to self-maintain and, thus, having something that can be called self-interest. I suggest that this way of framing the issue is unnecessarily anthropomorphic. To ask whether a species is alive, whether it possesses self-interests, whether it is a source of activity etc. are epistemically inaccessible questions[25]. I suggest that the relevant and epistemically accessible question that can be framed in scientifically amenable terms is rather whether the collective causal agency of a supra-organismal aggregate can be purely accounted in terms of their components' causal agency; that is, whether they function analogously to multicellular organisms. In brief, the question of putative self-interest can be framed in terms of organismality: in what sense do species exhibit causal capacities analogous to those exhibited by multicellular organisms? Let me unpack this point.

Consider Johnson's proposal that species possess self-interest in maintaining genetic diversity. The problem of this view is that, first, genetic diversity is a purely additive property of the species because it is computable by knowing the genetic diversity of its constituent individual organisms. Most importantly, properties of this kind can hardly ground the causal agency of species for the reason that the existence of variation is not necessarily indicative of any self-maintaining or goal-directed behaviour of the species[26]. A more promising alternative is to show that there exist characteristic species' behaviours over and above that of

the multicellular organism is alive independently of its component cells equally confused: is the multicellular organism alive because the majority of its component cells are alive and organized in a particular fashion or because of additional reasons? These seem to me epistemically inaccessible questions.

[24] Sandler, Crane 2006.

[25] Epistemic inaccessibility in this sense reflects the confused nature of the question at issue. Epistemically inaccessible questions might, however, become amenable to scientific investigation when anthropomorphic biases are expunged and proper explication or conceptual analysis is provided.

[26] The notion of genetic diversity implies the existence of a plurality of organisms with different genomes; in this sense, this is a species' aggregative property, not a property of any single organism. Analogously, chemical diversity is a property of the group of rocks varying in chemical composition rather than of any single rock. However, as there is no reason to posit causal agency on the part of the group of rocks in order to account for chemical diversity, so there is no reason per se to posit the causal agency of the species in order to account for genetic diversity; in both cases, diversity could be just the outcome of processes that are not dependent on the collective behaviour of the group of rocks or organisms. I thank an anonymous reviewer for highlighting this point.

the constituent individual organisms. For instance, Eldredge and Gould propose that the capacities of species to maintain genetic and phenotypic uniformity between their members through causal processes such as developmental and genetic homeostasis ground attributions of individuality (i.e., organismality) to species[27]. But I would argue that even developmental and genetic homeostases are processes that can be fully unpacked in terms of the causal interactions between the individual organisms of the species. For instance, the elimination of less fit hybrids and phenotypically "deviant" organisms caused by genetic homeostasis (i.e., stabilising selection) seems to be accountable in terms of lower reproductive success. In my opinion, a stronger form of organismality that is not straightforwardly reducible to the causal agency of individual organisms is needed, a form that parallels the organismality of multicellular organisms, whose behaviour is not reducible to the causal capacities of the constituent molecules or cells. An important critical contribution in this sense has been suggested by Cahen[28], who argued that species (or ecosystems) do not possess independent self-interests because their constituent organisms are not like the cells of multicellular organisms, whose behaviour is *subordinated to the organism's goals*. Following Cahen's insight, what needs to be ascertained is whether – contrary to what Cahen claimed – there exist species-level mechanisms for the "subordination" of organismal behaviour analogous to those intuitively at work in the case of multicellular organisms. I suggest that without evidence in favour of the existence of such mechanisms, any argument defending the causal agency of species is destined to remain weak.

I hope the reader realises that this is the same problem treated in the political philosophy literature in the attempt to ground collective responsibility via the ascriptions of some form of causal agency to the collective. As related in Section 1, the basic issue in the political philosophy literature is to distinguish the organisational features making a group of people a conglomerate rather than a mere aggregate collective, where in the former case the causal agency of the collective is irreducible to the causal capacities of its constituent individual organisms. It is in this sense that the resistance to methodological individualism in the social sciences and the resistance to reductionism in the life sciences are instances of the same attempt to ground the independent causal agency of composite structures or organisations such as conglomerate collectives or multicellular organisms[29]. Thus, if my criticism of Johnson's argument is con-

[27] Eldredge, Gould 1972.

[28] Cahen 1988.

[29] This is not surprising because, after all, the explanation of aggregate behaviour is one of the central problems of both the life and social sciences. The body politic analogy illustrated in Section 1 captures the same point: the problem of explaining how cells interact within a multicellular organism is structurally analogous to the problem of explaining how the individual organisms

vincing, instead of focusing on the vindication of anthropomorphically-based ascriptions of properties and causal capacities such as being alive and possessing self-interests, a more promising way to proceed to understand species' putative causal agency is in terms of organismality.

3. Species' organismality

The theory of organismality is a theory of biological individuality studying the nature of the relationships between the components of a biological system rendering it a physiological and/or evolutionary unit exhibiting "unanimity of interest"[30]. This theory can be applied in principle to any aggregate biological system, including unicellular organisms, mono-species and multi-species aggregates of unicellular organisms (e.g., biofilms, symbiotic associations), multicellular organisms, multi-organismal aggregates such as species up to ecosystems and the entire biosphere. What I aim to explore is whether also multi-organismal aggregates such as our species might exhibit sophisticated forms of organismality that justify collective causal agency ascriptions. Two basic points about theories of organismality should be highlighted. First, organismality is not a categorical but a continuous property; thus, the corollary is that some aggregates might be more organismal than others. Secondly, organismality is biologically instantiated in multiple ways via a variety of mechanisms.

The gradualness of organismality can be misunderstood in three ways. The first is that there is no direct correlation between size and organismality. On the one hand, a smaller bacterium is more organismal than a mono-species biofilm. On the other, a bigger multicellular organism such as a human is more organismal than a microscopic multi-species biofilm. The reason, as we shall see below, is that bacteria and multicellular organisms possess more sophisticated mechanisms of control and subordination of components' behaviour than biofilms. A corollary is that small species localised in a very small patch of land are not necessarily more organismal than a species geographically dispersed for the reason, again, that organismality depends on the existence of mechanisms of control and subordination of species members' behaviour[31]. The second way in which the gradualness of organismality might be misunderstood concerns the comparison between aggregates at the same level of the biological hierarchy: they

in a society interact. All these phenomena can somehow be treated as social and, for this reason, amenable to be explained – as I shall show in Section 4 – via various methodological stances that can be categorised as atomism, methodological individualism and holism (Levine *et al.* 1992).

[30] Queller, Strassmann 2016.

[31] Mechanisms of control and subordination of species members' behaviour intuitively work better at small spatial scales for most species. However, in the case of our species, this is not necessarily so. See below in the Section.

do not necessarily display the same degree of organismality. Some multicellular organisms, symbiotic associations and ecosystems might be more organismal than others. Organismality depends on the details of the evolutionary history of the biological system taken into consideration. The same point applies to species: different species display different degrees of organismality and this depends on their evolutionary history. In this sense, our species has evolved a plethora of cultural means through which it can enhance the cooperation and reduce conflict between its constituent organisms that are lacked by other species, like pine trees or wild boars. Finally, a third misinterpretation of the gradualness of organismality is significantly advocated by the same proponents of the idea: in fact, Queller and Strassmann argue that species «are never organisms»[32]. Given the a-categorical nature of organismality, it trivially follows that the fact that a species is not sufficiently organismal at time t^1 does not mean that it might eventually become sufficiently organismal at t^n.

A taxonomy of the biological properties realising organismality has been provided by many authors[33]. Some of these properties (i.e., partner fidelity of the components of the aggregate or tendency to reproductive co-transmission)[34] are irrelevant for our analysis as they are tailored to conceptualise the organismality of multi-species aggregates, a problem that eludes the central question of this article which specifically concerns the organismality of our species as a *mono-species* supra-organismal aggregate, i.e., constituted merely of humans. Another property concerns the genetic homogeneity of the components of the aggregate: the more genetically homogeneous are the components of the aggregate, the more organismal the aggregate. The cells of a multicellular organism are, given their common origin from a single reproductive event of fertilization, generally genetically homogeneous (excluding, for instance, somatic mutations). Of course, many multicellular aggregates, despite being somehow organismal, are not so homogeneous (e.g., Portuguese Man of War or lichens). Other multi-organismal aggregates (e.g., bee and ant colonies) are genetically homogeneous and for this reason are sometimes labelled "superorganisms". The organisms of our species are not genetically homogeneous. Of course, our species might be characterised through statistical artefacts such as a reference genome, or might even be characterisable for some of its history in terms of a set of genomic properties, but the genomic uniformity of the constituent organisms of our species is never guaranteed and always open to change through evolutionary history. In this sense, our species is more like a genomically diverse multicellular organism. Note however that genetic homogeneity is implicitly a proxy for relative lack of competition and increased cooperation between components. It is therefore a

[32] Queller, Strassmann 2016: 859.

[33] Pepper, Herron 2008; Queller, Strassmann 2009 and 2016.

[34] Queller, Strassmann 2016.

measure of genomic adaptive beneficial cooperation. Let us now consider two properties realising organismality that are particularly relevant for evaluating our analogy between multicellular organisms and species.

a. *Spatial proximity* of the components: the more the components of the aggregate live spatially proximate, the more organismal is the aggregate. The macromolecular components of a bacterium are enclosed in a membrane and interact appropriately by sustaining the bacterium's life. The cells of a multicellular organism are also enclosed in a limited space and interact appropriately by sustaining the life of the multicellular aggregate. Species, on the other hand, do not possess clear boundaries like membranes or epidermis[35].

b. *Adaptive beneficial cooperation* between the components: the more the components of the aggregate are involved in interactions of beneficial cooperation, the more organismal the aggregate. The cells of a multicellular organism are durable partners because they have evolved to benefit each other: cells relinquish some of their innate tendencies (e.g., proliferation) in order to benefit the aggregate. Cells interact in multifarious ways by regulating, constraining and sanctioning each other's behaviour. They exhibit *integrative* (not merely response) cohesion[36]. Response cohesion is the capacity of components to behave in a coordinated manner to the same kind of environmental stimulus without significant causal interaction between them. The coordinated behaviour is just the result of the similar, though uncoordinated, responses of the individual components of the aggregate. Cellular responses are a chief example of integrative cohesion and coordinated behaviour; any environmental stimulus will result in an integrative and coordinated response: drastic temperature increases will induce production of heat shock proteins on the part of cells which will benefit the entire multicellular organism; pollution and UV light exposure will induce up-regulation of the cellular mechanisms of Dna repair and the consequent reduction in somatic mutations that will equally benefit the entire multicellular organism etc. Cellular differentiation is a particularly clear example of regulated, integrative and coordinated behaviour. Cells differentiate according to relational properties of the developmental context: if the same cells were put in contact with a different set of cells (e.g., in a different tissue), they would differentiate differently. This means that «A single cell isolated from either one of these tissues [....] fails to

[35] Note that spatial proximity does not seem to apply to our species and that this property is in tension with the first misunderstanding of the notion of organismality highlighted above (i.e., that small species localised in a very small patch of land are not necessarily more organismal than a geographically dispersed species). This tension will be solved below in the Section, when organismality criteria are applied to species.

[36] Barker, Wilson 2010.

originate the tissues that would result from their reciprocal interactions»[37]. It is for this reason that cellular differentiation can only be explained by taking into account both the relational and intrinsic (e.g., genetic) properties of cells (making atomistic accounts of cellular behaviour hopeless, see Section 4).

Multicellular organisms possess the two above properties in high degree. Most significantly, they possess a set of biologically realised "enforced standards of conduct" that, translated in a different social context, parallel what French (see Section 1) considers the set of mechanisms for regulating the behaviour of the individual organisms of conglomerate collectives[38]. Multicellular organisms also possess a set of mechanisms of subordination of cellular behaviour to the organism's goals that Cahen (see Section 2) sees as the principal difference between them and multi-organismal aggregates like species[39]. These are all evolved mechanisms of adaptive beneficial cooperation, cooperation enhancement, reduction of conflict, reciprocal regulation, constraint and sanction of components' behaviour. I thus suggest that, of all the properties realising organismality, adaptive beneficial cooperation is the most important.

Let us now consider whether our species can be organismal in the above senses. Does the relative lack of spatial proximity prevent the possibility of suitable causal interactions? The geographical distribution of our species at the moment is striking: humans have managed to colonise almost every pocket of the planet. Our species has a complex metapopulation structure, with the members of several subpopulations interacting reproductively mostly between themselves.

However, spatial dispersion might not necessarily quell the appropriate interaction making an aggregate organismal. For instance, globalisation through technology provides the means for reducing spatial dispersion: long-distance travels and social networks work on this very principle. So, even though it might be argued that the mechanisms of control and subordination of species members' behaviour intuitively work better at small spatial scales for most species, our species is peculiar. The point can be elucidated in a different way; compare the organismality of our species when it emerged in a localized African area as a very small and geographically isolated population thousands of years ago and the organismality of our species today; my point is that today, despite its astonishing geographical dispersion and demographic explosion, our species is more organismal, basically because of globalisation. More fundamentally, even though the huge number of extant organisms constituting our species are hugely dispersed and not genetically homogeneous, this does not impinge on the possibility that forms of adaptive beneficial cooperation emerge. This means that,

[37] Soto, Sonnenschein 2011: 333.

[38] French 1984.

[39] Cahen 1988.

despite lacking certain organismality properties, our species might nonetheless display a high level of organismality. In fact, it seems to me that our species is the most organismal. As a species, we have acquired, through biological and, especially, cultural evolution, mechanisms that parallel the evolved mechanisms of adaptive beneficial cooperation, cooperation enhancement, reduction of conflict, reciprocal regulation, constraint and sanction of cellular behaviour illustrated in the case of multicellular organisms. Humans are unlike pine trees and wild boars in possessing rich cultural mechanisms and social norms in order to realise significant forms of integrative cohesion. Again, I suggest that it is chiefly the existence of these mechanisms that might justify ascriptions of collective causal agency.

4. Understanding collective causal agency

In this Section I shall consider what kind of explanatory strategy should be used in order to understand collective causal agency. Again, I shall answer this question by using the analogy between multicellular organisms on the one hand and our species on the other. As it was anticipated at the end of Section 2, the behaviour of aggregates could be explained in reductionist (e.g., atomistic, methodologically individualist) and anti-reductionist (e.g., holistic) terms.

Starting with multicellular organisms, the history of developmental biology is quite revealing about the constant battle between reductionist and anti-reductionist explanatory tendencies[40]. In Section 3 we already discounted atomistic accounts focusing solely on the intrinsic properties of cells as limited. An explanation of why a pluripotent cell becomes a nerve or liver cell cannot be couched, for instance, in purely genetic terms as if Dna were the sole developmental cause. Dna is expressed appropriately because the cell in which it is localised regulates its expression, where this regulation is in its turn causally affected by the complex processing of the molecular signals that the cell receives from its neighbouring cells, cells that in turn are part of relational structures such as specific tissues. To account for differentiation in purely genetic terms would be to discount the regulatory causal role of the cell as well as that of the relational context of the tissue. Dna in a hierarchically organised multicellular context actualises causal capacities because of such regulatory contexts. In a nutshell, a "cellularised" Dna molecule is not the same as an isolated Dna molecule. The problem does not fade away if a reductionist explanation considers as relevant causes entities belonging to different hierarchical levels such as Dna molecules and cells. Consider the process of cancer formation. A reductionist explanation might be couched in terms of the mutational capacities of the cell

[40] Vecchi, Hernández 2014.

that will eventually abandon the default state of quiescence and resume proliferation, becoming cancerous. This explanation discounts as irrelevant the causal influence of supra-cellular structures such as tissues. But when cancerous cells are transplanted or injected in healthy tissues, their behaviour is "normalised", reverting to a non-cancerous state[41]. One entity that seems causally efficacious in this case is the tissue that, through the causal influence of its architectural properties, regulates the cell's behaviour. Again, a "tissueised" cell is a different causal agent from the isolated cell[42].

Let us now consider our species' behaviour. Consider the following example. Chlorofluorocarbons (CFCs) were used as refrigerating agents since the 1930s without knowledge of their potential risk on the ozone layer and, consequently, on the biosphere. After the risk was realized in 1970's, it triggered a *concerted response* on the part of many local and global organisations finally resulting in their worldwide ban in 1992. One global organisation involved in the concerted response was the UNEP (i.e., United Nations Environmental Programme), which established in 1977 the Coordinating Committee on the Ozone Layer, leading the way by imposing obligations to limit greenhouse gas emissions. One less global but still transnational organisation, the European Union, implemented several mechanisms of constraint and sanction of individual organisms' behaviour: "collectively irresponsible" people could either be prevented from buying CFC polluting fridges or they could be sanctioned. I am pretty sure everybody would agree that atomistic explanations are hopeless in this context too: there is no intrinsic causal capacity (e.g., law-abidance, environmentalist conscience) that makes individual organisms behave as they do. Thus, either a methodological individualistic or a holistic explanation seems necessary. Consider the first case. Elster defines methodological individualism as the thesis that all social phenomena:

> are in principle explicable in ways that only involve individuals – their properties, their goals, their beliefs, and their actions. To go from social institutions and aggregate patterns of behavior to individuals is the same kind of operation as going from cells to molecules»[43].

According to Elster, the way to explain the pattern of behaviour of collectively irresponsible individuals is through other individuals' influence.

[41] Soto, Sonnenschein 2011: 338.

[42] My analysis implies that some form of holistic explanation should be favoured in many cases in biology. Nevertheless, this is not the place to unpack the complex debate concerning the nature of holistic explanation. Suffice to say that some form of control of the macro-level over the micro-level must occur that is not accountable merely in constitutive terms (Craver and Bechtel 2006), but rather in causal ones (Santos 2015).

[43] Elster 1985: 5.

Suppose that what needs explaining is my failure to buy a Cfc polluting but inexpensive fridge in Portugal: the methodologically individualistic explanation would unpack the causal role of the Unep and European Union's ban in terms of the series of interactions between the people who know about the ban and who implement it and who, in the final instance, prevent me from buying the fridge. After all, the methodological individualist argues, all social organisations are constituted of individual people. This kind of explanation is structurally analogous to explanations of cellular differentiation in genetic terms and of cancer formation in terms of the mutational capacities of cells. I have criticised such kinds of explanations above in this Section. For this reason, I find Elster's quip that there is something fundamentally wrong in explaining molecular phenomena partially in terms of cellular behaviour as a relic of a bygone reductionist age. The alternative I propose is to resort to some form of holism. Holistic explanations posit the causal influence of "social structures". Institutions like the Unep, the European Union etc. are, after all, not solely constituted of individual people, but of documents, laws, directives, initiatives etc.[44]. They also rely, for the implementation of their constraining and sanctioning mechanisms, on national institutions (i.e., Portugal) and other more local social structures (e.g., the Lisbon local authority). Furthermore, even though social structures are partially ontologically constituted of individual people (i.e., organisms), they are multiply realisable (for instance through continuously changeable executive and legislative bodies) by different individual organisms. Most importantly, social structures causally affect the behaviour of individual people. In this sense, the holistic explanation is analogous to the explanation of cellular differentiation in terms of the regulatory causal role of the cellular and tissue relational contexts as well as to the holistic explanation of cancerous cell's normalization illustrated above. In all these cases, what we see at work are enforced standards of conduct[45], mechanisms of subordination[46], policing systems[47], mechanisms of sanction based on the imposition of rules constraining the behaviour of "collectively irresponsible" components (e.g., cancerous cells and people lured by polluting fridges). For all these reasons, I suggest that the causal capacities of such social structures cannot be unpacked purely in terms of the interactions of

[44] Ferraris 2009; Ferraris 2012.

[45] French 1984.

[46] Cahen 1988.

[47] Queller, Strassmann 2016.

the constituent individual organisms[48]. A "socialised" individual organism is a different causal agent from the isolated individual organism[49].

5. Making sense of species' moral responsibility

I have so far defended the thesis that our species might be considered highly organismal because of the existence of a set of mechanisms of reciprocal regulation, constraint and sanction of individual organisms' behaviour that is sufficiently analogous to those regulating developmental and physiological processes in multicellular organisms. I suggest that it is chiefly the existence of these mechanisms that justifies ascriptions of collective causal agency to supra-organismal entities. While there is little doubt that our species is the most organismal, it is beyond the scope of this paper to provide an articulate analysis concerning the origin, richness and nature of these mechanisms. This is, after all, the province of cultural evolution studies, human anthropology, economics, sociology and political theory. Only these sciences would be able to provide the necessary evidence in favour of the empirical hypothesis that the organismality of our species is high enough for causal agency ascriptions. Nonetheless, and despite the possible limitations that analogical reasoning might have, high organismality would ground ascriptions of causal agency to our species. Furthermore, given that organismal causal agency is a necessary condition for moral responsibility, the claim that our species – or, better, the human population at the moment – is morally responsible towards the biosphere and future human generations for causing climate change, biodiversity loss, ecosystem upheaval etc. is not without foundation.

Moral responsibility ascription to the extant human population implies that responsibility cannot be fully reduced to that of individual members of our species or to other social groups. And here lies the rub. The problem is that it is certainly the case that some sub-species social entities are more organismal than the entire human population, e.g., nation states, religious groups, lobbies, criminal gangs etc. There is no doubt that the distinction between *local* and *global* norms and mechanisms of regulation, constraint and sanction of individual organisms' behaviour is crucial. Nobody would doubt that many local sub-species social entities regulate individual organisms' behaviour by the establishment of a set of local norms and local mechanisms of social control. In the rather trivial example provided in Section 4, the global institution is the Unep, while EU, nation states

[48] See Levine, Sober, Wright 1992 and Schwartz 1993 for alternative but analogous criticisms of methodological individualism.

[49] I thank Gil Santos for extensive discussions on this issue and for, as much as I know, coining the useful terminology of "cellularised" Dna molecules and "socialised" individual organism. However, the terrible expression "tissueised" cell, equally inspired, is my entire fault.

and local authorities implement increasingly local norms and mechanisms of social control. The problem posed by this form of hierarchical and decentralised local control is that its existence allows apportioning causal and, henceforth, moral responsibility to local social actors rather than the entire species whenever the former are organismal enough. Unless global mechanisms of control constrain the behaviour of local social actors, possible competition and conflict between such local actors will ensue, with moral blame apportioned at the local level[50]. It is because of this fundamental theoretical problem that I propose to interpret the organismality thesis applied to our species in a cosmopolitan sense: only when the whole species, rather than some of its groups, is an organismal causal agent, we can make sense of its moral responsibility. Put differently, the extant human population can be morally responsible only when it can be considered as a *global causal agent*, that is, only when *global* norms and *global* mechanisms of social control of individual organisms' behaviour exist[51]. But if the extant human population can be morally responsible only when it can be considered as a *global causal agent,* the analogy between multicellular organisms and our species might be seen as problematic. In a way, the form of globalism or cosmopolitanism I suggest seems to require an explanation in terms of centralised control modelled in analogy to human agency (see Section 1). However, I think that we need to resist this conclusion for the following reason.

Analogies, despite being fruitful analytical tools, might lead us astray when the conceptualisation of the behaviour of hierarchically organised integrated systems is at stake. A multicellular organism is an integrated system made up of highly organismal cells and increasingly less organismal substructures such as tissues and organs. Humans are multicellular organisms with a highly evolved centralised nervous system. Nonetheless, they are still integrated systems made up of highly organismal cells and increasingly less organismal substructures such as tissues and organs. Indeed, the centralised nervous system is one very important substructure. The cells and substructures of multicellular organisms are analogous to the local social norms in the case of our species; they also behave analogously, reciprocally regulating, constraining and sanctioning the behaviour of other components and substructures of the integrated system. This nested hierarchy of components behaves in a distributed fashion without centralised control. The only way to make biological sense of the notion of centralised control at the heart of the human agency analogy is by postulating a peculiar kind of dictatorial control on the part of the centralised central nervous system, which would be seen as determining the

[50] I thank an anonymous reviewer for highlighting this critical point.

[51] The point is that, for instance, if the World Health Organisation could enforce the implementation of specific health policies on a global level (e.g., following South Korea's policy of mass testing in the Covid-19 pandemic case) and curtail the application of national policies in contravention with its dictates (like those of Sweden in the Covid-19 pandemic case), the extant human population would be more organismal.

entire behaviour of the multicellular organism by itself, effectively as a homunculus. But this postulation is highly disputable in biology, not only for the reasons anticipated in Section 1[52], but also because theoretical analysis of the behaviour of complex systems shows that decentralised control enhances their integration[53], making the human agency analogy out-dated. If our species is highly organismal, it should exhibit the kind of decentralised control typical of distributed and integrated complex systems like multicellular organisms. The cosmopolitan or globalist interpretation I propose does not require centralised and dictatorial control, but rather the nested type of distributed and reciprocal control of integrated complex systems where local and global structures causally affect each other. Accordingly, the extant human population can be seen as a global causal agent only insofar as global norms and global mechanisms of social control causally affect the behaviour of local social actors and individual organisms. It is only for this type of causal influence that the global causal agent is morally responsible.

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[52] Varela 1991; Noble 2008.

[53] Bechtel, Richardson 2010.

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